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09/560,723	04/28/2000	Shigeki Watanabe	837.1953/JDH	5245

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EXAMINER	
KIM, DAVID S	

ART UNIT	PAPER NUMBER
2633	

DATE MAILED: 03/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/560,723	WATANABE, SHIGEKI	
	Examiner	Art Unit	
	David S. Kim	2633	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,6-9 and 12-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,6-9 and 12-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. Applicant's response to the rejections of claims 1, 3, and 6-18 under 35 U.S.C. 112, first paragraph, in the previous Office Action (mailed on 09 September 2005) is noted and appreciated. Applicant responded by introducing amendments to independent claims 1, 14-15, and 17. These amendments overcome the previous rejections of claims 1, 3, and 6-18 under 35 U.S.C. 112, first paragraph. Accordingly, these rejections are presently withdrawn.

Claim Rejections - 35 USC § 103

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. **Claims 1, 3, 9, 12-17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97 ("All-optical fiber signal processing and regeneration for soliton communications", hereinafter "Bigo 10/97"), with reference to Alfano et al. (U.S. Patent No. 5,323,260, hereinafter "Alfano"), Ramaswami et al. (*Optical Networks: A Practical Perspective*, hereinafter "Ramaswami"), Smith et al. ("All-optical clock recovery using a mode-locked laser", hereinafter "Smith 9/92"), and Ellis et al. ("All optical clock recovery at bit rates up to 40 Gbit/s", hereinafter "Ellis"). See MPEP 2131.01 for information on the application of multiple references for 102-type treatment of claims.

Regarding claim 1, Bigo 10/97 discloses:

An optical apparatus (Fig. 9) comprising:

an optical path (path from data input to clock output in Fig. 9) provided between an input port (data input in Fig. 9), which is connected to a first optical fiber (waveguide input into Fig. 9 is conventionally an optical fiber), and to which signal light modulated at a frequency f_s (p. 1215, col. 1, 2nd paragraph) is supplied, and an output port (clock output in Fig. 9); and

an optical loop (loop in Fig. 9) optically coupled to said optical path;

said optical loop including:

an optical amplifier (EDFA in loop in Fig. 9) for compensating for a loss in said optical loop so that laser oscillation of a continuous wave having a wavelength λ_c (λ_c in Fig. 9) occurs in said optical loop;

an adjuster (optical delay line in Fig. 9, p. 1215, col. 1, 1st paragraph) for adjusting an optical path length of said optical loop so that said frequency f_s becomes equal to an integral multiple of the reciprocal of a recirculation period of said optical loop;

an optical bandpass filter (filter in loop in Fig. 9) that allows light having said wavelength λ_c only to pass; and

a nonlinear optical medium (p. 1214, col. 2, last paragraph – p. 1215, col. 1, 1st paragraph) for mode-locking said laser oscillation according to said signal light,

wherein said nonlinear optical medium performs modulation (p. 1220, col. 2, last paragraph) of said continuous wave by said signal light to obtain light having said wavelength λ_c.

Bigo 10/97 does not expressly disclose:

wherein said nonlinear optical medium includes a second optical fiber to which said signal light of said input port is inputted from said optical loop, and said continuous wave having said wavelength λ_c is inputted from said optical loop, and

said nonlinear optical medium performs said ***amplitude modulation by four-wave mixing using said signal light as pump light***.

However, notice that Bigo 10/97 teaches that the nonlinear optical medium may be embodied by a variety of intracavity modulators (p. 1215, col. 1, end of 1st paragraph). One of these choices is a Kerr fiber modulator (KFM), which comprises an optical fiber. In such an embodiment, the apparatus of Bigo 10/97 would comprise the "second optical fiber" limitation above. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ such an embodiment in the apparatus of Bigo 10/97. One of ordinary skill in the art would have been motivated to do this since KFM's have the potential for use with high amounts of bandwidth (p. 1215, col. 1, end of 1st paragraph).

Regarding the "amplitude modulation" limitation above, Bigo 10/97 is silent about such amplitude modulation. However, notice that a KFM performs at least one form of modulation, cross-phase modulation (XPM) (Bigo 10/97, p. 1209, col. 1, last paragraph). Additionally, it is known that XPM may be accompanied by four-wave mixing (FWM) (Alfano, col. 4, l. 19-21), which provides amplitude

modulation (Alfano, col. 4, l. 67 – col. 5, l. 2). The existence and/or strength of this FWM is based on the degree of phase matching between the interacting optical signals (Alfano, col. 5, l. 2-17). One situation that results in significant phase matching is when the interacting optical signals have wavelengths that are near the dispersion zero of an optical fiber (Ramaswami, p. 72, 2nd full paragraph).

So, the pertinent question to answer here is, "Would such FWM and amplitude modulation occur in the apparatus of Bigo 10/97?" In view of the prior art, the answer appears to be, "Yes." Notice that Bigo 10/97 refers to the KFM embodiments in Smith 9/92 and Ellis (Bigo 10/97, p. 1215, col. 1, end of 1st paragraph). These KFM embodiments both employ interacting optical signals with wavelengths that are near the dispersion zero of optical fibers (Smith 9/92, p. 1815, col. 2, 1st paragraph; Ellis, p. 1323, col. 1, last paragraph – p. 1324, col. 1). In view of Smith 9/92 and Ellis, it appears that the apparatus of Bigo 10/97 with a KFM would employ interacting optical signals with wavelengths that are near the dispersion zero of an optical fiber. Such a situation would result in significant phase matching, and such phase matching would result in the FWM and amplitude modulation described above. Accordingly, such an apparatus of Bigo 10/97 would read on the "amplitude modulation" limitation above.

Additionally, notice the remarkable similarities between the structure and operational details of Bigo 10/97 (e.g., Fig. 9 in view of the prior art and argument presented above) and Applicant's invention (e.g., Fig. 1). Such similarities strongly suggest that the apparatus of Bigo 10/97 (in view of the prior art and argument presented above) is substantially identical to Applicant's invention. This kind of situation is similar to MPEP 2112.01, section I. At first glance, it may appear that Applicant's invention differs from Bigo 10/97 since Applicant's focuses on FWM and its related amplitude modulation while Bigo 10/97 is silent about FWM. However, in view of the prior art and argument presented above, it appears that FWM and its related amplitude modulation would occur in the apparatus of Bigo 10/97 (with a KFM embodiment).

Regarding claim 3, Bigo 10/97, as applied to claim 1 above, discloses:

An optical apparatus according to claim 1, further comprising an optical coupler (50/50 coupler in Fig. 9) for optically coupling said optical path and said optical loop, said optical coupler providing a part of said optical path and a part of said optical loop.

Regarding claim 9, Bigo 10/97, as applied to claim 1 above, discloses:

An optical apparatus according to claim 1, further comprising an input optical amplifier (EDFA connected to data input in Fig. 9) optically connected to said input port for amplifying said signal light.

Regarding claim 12, Bigo 10/97, as applied to claim 1 above, discloses:

An optical apparatus according to claim 1, further comprising a waveform shaper (NOLM in Fig. 11) optically connected to said output port for performing waveform shaping of said signal light according to an optical clock output from said output port.

Regarding claim 13, Bigo 10/97, as applied to claim 12 above, discloses:

An optical apparatus according to claim 12, wherein said waveform shaper comprises a nonlinear optical loop mirror (NOLM in Fig. 11).

Regarding claim 14, claim 14 is a system claim that corresponds largely to the apparatus claim 1. Therefore, the recited means in apparatus claim 1 read on the corresponding means in system claim 14. Claim 14 also includes a limitation absent from claim 1. This limitation is:

an optical fiber transmission line for transmitting signal light modulated at a frequency f_s; and the second optical fiber included in the optical loop.

Bigo 10/97, as applied to claim 1, also discloses such a transmission line (line input to "1:2 clock recovery" unit in Fig. 11) and the second fiber optical fiber included in the optical loop (fiber ring in Fig. 9).

Regarding claims 15-16, claims 15-16 are system claims that correspond largely to the apparatus claims 12-13, respectively. Therefore, the recited means in apparatus claims 12-13 read on the corresponding means in system claims 15-16. Claims 15-16 also include limitations absent from claims 12-13. These limitations are also disclosed by Bigo 10/97:

an optical fiber transmission line (optical fiber link on p. 1216, col. 1, last paragraph; input fiber transmission line to Fig. 11) for transmitting signal light; and

at least one optical repeater (regenerator stage on p. 1216, col. 2, 1st paragraph; e.g., Fig. 11) arranged along said optical fiber transmission line;

each of said at least one optical repeater comprising:

an optical clock regenerator (Fig. 9., p. 1216, col. 2, 1st paragraph) for regenerating an optical clock by mode locking of laser oscillation according to said signal light.

Regarding claim 17, claim 17 is a method claim that corresponds to apparatus claim 1. Therefore, the recited means in apparatus claim 1 read on the corresponding steps in method claim 17.

4. **Claims 6 and 8** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97, as applied to claim 1 above, with further reference to Greer et al. ("All-optical FM mode-locking of fibre laser", hereinafter "Greer"). See MPEP 2131.01 for information on the application of multiple references for 102-type treatment of claims.

Regarding claim 6, Bigo 10/97 refers to Smith 9/92 and Ellis, both of which refer to Greer, discloses:

An optical apparatus according to claim 1, wherein said nonlinear optical medium comprises a single-mode fiber (Greer, p. 1741, col. 1, last paragraph).

Regarding claim 8, Bigo 10/97, in view of the cited prior art above, discloses:

An optical apparatus according to claim 6, wherein said nonlinear optical medium has a zero dispersion wavelength substantially equal to the wavelength of said signal light (notice proximity of zero dispersion wavelength and wavelength of signal light in Smith 9/92, p. 1815, col. 2, 1st paragraph, Ellis, p. 1323, col. 2, last paragraph – p. 1324, col. 1, Greer, p. 1742).

5. **Claims 7 and 18** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97, as applied to claim 1 above, further in view of Smith (U.S. Patent No. 5,548,433, hereinafter "Smith '433").

Regarding claim 7, Bigo 10/97, as applied to claim 1 above, discloses: '

An optical device according to claim 1, wherein said nonlinear optical medium comprises a dispersion shifted fiber (notice that the dispersion zero of the fibers in Smith 9/92 and Ellis are near 1550 nm, which is characteristic of DSF, as standard single-mode fiber has the dispersion zero around 1310 nm, Ramaswami, p. 229).

Bigo 10/97, as applied to claim 1 above, does not expressly disclose:

said dispersion shifted fiber is ***highly nonlinear***.

Smith '433 teaches such a nonlinear optical medium (col. 9, l. 18-21). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate a highly nonlinear dispersion shifted fiber as the nonlinear optical medium of Bigo 10/97, as applied to claim 1 above. One of ordinary skill in the art would have been motivated to do this since doing so would enable one to practice the optical device of Bigo 10/97, as applied to claim 1 above, with shorter cavity lengths (col. 9, l. 11-12), providing advantages regarding lock-up time (col. 9, l. 11-12) and an obviously more compact optical device.

Regarding claim 18, Bigo 10/97, as applied to claim 7 above, further in view of Smith '433, discloses:

An optical device according to claim 7, wherein said nonlinear optical medium has a zero-dispersion wavelength substantially equal to the wavelength of said signal light (notice proximity of zero dispersion wavelength and wavelength of signal light in Smith 9/92, p. 1815, col. 2, 1st paragraph, Ellis, p. 1323, col. 2, last paragraph – p. 1324, col. 1).

Response to Arguments

6. Applicant's arguments with respect to the combination of the teachings from Bigo 10/97 and Watanabe (U.S. Patent No. 5,596,667) have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Tsunoda et al. (JP 09-321372 A) is cited to show related a related apparatus and method for providing optical clock recovery based on mode-locking and four-wave mixing.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Kim whose telephone number is 571-272-3033. The examiner can normally be reached on Mon.-Fri. 9 AM to 5 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth N. Vanderpuye can be reached on 571-272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DSK

KENNETH VANDERPUYE
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